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09/638,075	08/11/2000	Hiroji Hanawa	4609 USA/ETCH/DICP	1010

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EXAMINER	
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ART UNIT	**PAPER NUMBER**
1753	7

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/638,075	Applicant(s) Hanawa et al.
	Examiner Rodney McDonald	Art Unit 1753

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1) ☐ Responsive to communication(s) filed on _____.

2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.

3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

Disposition of Claims

4) ☒ Claim(s) *1-28 and 30-37* is/are pending in the application.

4a) Of the above, claim(s) _____ is/are withdrawn from consideration.

5) ☐ Claim(s) _____ is/are allowed.

6) ☒ Claim(s) *1, 4-6, 8-10, 12-14, 20-22, 24, 27, 28, 34, and 36* is/are rejected.

7) ☒ Claim(s) *2, 3, 7, 11, 15-19, 23, 25, 26, 30-33, 35, and 37* is/are objected to.

8) ☐ Claims _____ are subject to restriction and/or election requirement.

Application Papers

9) ☐ The specification is objected to by the Examiner.

10) ☐ The drawing(s) filed on _____ is/are objected to by the Examiner.

11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved.

12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

13) ☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

a) ☐ All b) ☐ Some* c) ☐ None of:

1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

*See the attached detailed Office action for a list of the certified copies not received.

14) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

15) ☐ Notice of References Cited (PTO-892)
16) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
17) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s). 2
18) ☐ Interview Summary (PTO-413) Paper No(s). _____
19) ☐ Notice of Informal Patent Application (PTO-152)
20) ☐ Other:

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless --
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 1, 5, 6, 10, 13, 14, 20-22, 27, 28, 34 and 36 are rejected under 35 U.S.C. 102(b) as being anticipated by Reinberg et al. (U.S. Pat. 4,431,898).

Reinberg et al. teach in Fig. 2 an embodiment in which etching takes place in the chamber. The embodiment of Fig. 2 comprises a tube structure 10. Tube structure 10 which is made up of legs 13, 14, 15 and 16 form an opening 17 and, therefore, a continuous path. Leg portion 13 encloses a larger volume than leg 13 of Fig. 1. The volume within leg 13 should be sufficiently large to house one or more wafers therein. (Column 3 lines 29-35)

The tube structure 10 also has an inlet 11 for receiving etching gases into chamber 27 and an outlet 12 connected to a source of vacuum, e.g., a pump similar to pump 25 of Fig. 1 for evacuating spent gases from plasma chamber 27. A platform 33 rests on the bottom portion 31a of jacket 31 for supporting a plurality of wafers 34 in an upright or flat position. The wafers 34 may be held in position by any convenient means. (Column 3 lines 36-46)

The tube structure 10 also has an inlet 11 for receiving etching gases into chamber 27 and an outlet 12 connected to a source of vacuum, e.g., a pump similar to pump 25 of FIG. 1 for

evacuating spent gases from plasma chamber 27 and maintaining the pressure within chamber 27 at a desired value. (Column 3 lines 47-52)

A transformer 20 comprises a ferrite or other appropriate magnetic material core 18 which encircles leg 15 and passes through opening 17 has a primary winding 19 of one or more turns. The transformer 20 of FIG. 2 functions identically as the transformer 20 of FIG. 1 and provides an inductively coupled A.C. power source 21 to generate a current in the continuous path of plasma chamber 27 formed by legs 13, 14, 15 and 16 which is the secondary of the transformer 20. This current generates a plasma of the etching gases to thereby perform etching of wafers 34. (Column 3 lines 53-63)

FIG. 3 is substantially identical to FIG. 2 except that FIG. 3 includes within plasma chamber 27 a conductive platform 37 on which one or more wafers 36 may rest. Conductive platform 37 is connected to a source of variable voltage 40, via conductor 39 which passes through the bottom portion 31a of jacket 31. Source 40 is a source of d.c. or a.c. voltage which may be varied to set the level of sheath voltage between the plasma and substrate, i.e., wafer 36, which voltage determines the manner in which ions are transported to the substrate. In some embodiments it may be necessary to add an additional electrode in contact with the plasma as a reference to the applied potential to the wafer. For a.c. bias this electrode may be outside the chamber and capacitively coupled to the plasma. (Column 3 lines 64-68; Column 4 lines 1-10)

Reinberg et al. teach that the tube structure 10 comprises four legs 13, 14, 15 and 16 which form a continuous closed path around an opening 17. The tube structure 10 is

topologically toroidal. The essential feature is that the gas discharge current path therein be in a complete loop, through the central opening of which the magnetic fluxes of primary and secondary are linked. (Column 2 lines 47-53)

3. Claims 1, 5, 6, 10, 13, 14, 20, 21, 22, 27, 28, 34 and 36 are rejected under 35 U.S.C. 102(e) as being anticipated by 09/584,167.

Application No. 09/584,167 teach the plasma reactor with the hollow conduit required by the claims.

The applied reference has a common assignee with the instant application. Based upon the earlier effective U.S. filing date of the reference, it constitutes prior art under 35 U.S.C. 102(e). This rejection under 35 U.S.C. 102(e) might be overcome either by a showing under 37 CFR 1.132 that any invention disclosed but not claimed in the reference was derived from the inventor of this application and is thus not the invention "by another," or by an appropriate showing under 37 CFR 1.131.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was

commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103© and potential 35 U.S.C. 102(f) or (g) prior art under 35 U.S.C. 103(a).

5. Claims 1, 4, 5, 6, 10, 13, 14, 20, 21, 22, 24, 27, 28, 34 and 36 are rejected under 35 U.S.C. 103(a) as being unpatentable over Reinberg et al. (U.S. Pat. 4,431,898) in view of Smith et al. (U.S. Pat. 6,150,628).

Reinberg et al. is discussed above and all is as applied above. (See Reinberg et al. discussed above)

The difference between Reinberg et al. and the present claims is that the tube being a metal is not discussed and the dividing the tube is not discussed.

Smith teach in FIG. 3 a schematic representation of a metallic plasma chamber 100 that may be used with the toroidal low-field plasma sources described in connection with FIG. 1. The plasma chamber 100 is formed from a metal such as aluminum, copper, nickel and steel. The plasma chamber 100 may also be formed from a coated metal such as anodized aluminum or nickel plated aluminum. The plasma chamber 100 includes imbedded cooling channels 102 for passing a fluid that controls the temperature of the plasma chamber 100. (Column 8 lines 52-61)

As shown, a first 104 and a second high Permeability magnetic core 106 surround the plasma chamber 100. The magnetic cores 104, 106 are part of the transformer 12 of FIG. 1. As

described in connection with FIG. 1. each of the first 104 and the second core 106 induce a potential inside the chamber that forms a plasma which completes a secondary circuit of the transformer 12. Only one magnetic core is required to operate the toroidal low-field plasma source. Applicants have discovered that an inductively-driven toroidal low-field plasma source can be made with a metallic plasma chamber. Prior art inductively coupled plasma sources use plasma chambers formed from dielectric material so as to prevent induced current flow from forming in the plasma chamber itself. The plasma chamber 100 of this invention includes at least one dielectric region that electrically isolates a portion of the plasma chamber 100 so that electrical continuity through the plasma chamber 100 is broken. The electrical isolation prevents induced current flow from forming in the plasma chamber itself. (Column 8 lines 62-68; Column 9 lines 1-13)

The plasma chamber 100 includes a first 108 and a second dielectric region 110 that prevents induced current flow from forming in the plasma chamber 100. The dielectric regions 108, 110 electrically isolate the plasma chamber 100 into a first 112 and a second region 114. Each of the first 112 and the second region 114 is joined with a high vacuum seal to the dielectric regions 108, 110 to form the plasma chamber 100. The high vacuum seal may be comprised of an elastomer seal or may be formed by a permanent seal such as a brazed joint. In order to reduce contamination, the dielectric regions 108, 110 may be protected from the plasma. The dielectric regions 108, 110 may comprise a dielectric spacer separating mating surface 116 of the plasma chamber 100, or may be a dielectric coating on the mating surface 116. (Column 9 lines 14-27)

The motivation for utilizing a metal chamber with a dielectric break is that it allows for preventing induced current flow from forming in the plasma chamber. (Column 9 lines 12-13)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified Reinberg et al. by utilizing a metal chamber and a dielectric separation as taught by Smith et al. because it allows for preventing induced current flow from forming in the plasma chamber.

6. Claims 1, 5, 6, 8-10, 12-14, 20-22, 27, 28, 34 and 36 are rejected under 35 U.S.C. 103(a) as being unpatentable over Reinberg et al. (U.S. Pat. 4,431,898) in view of Anderson (U.S. Pat. 3,291,715).

Reinberg et al. is discussed above and all is as applies above. (See Reinberg et al. discussed above)

The differences between Reinberg et al. and the present claims is that a coil winding between the conduit and the chamber is not discussed and wherein the winding has an outer diameter less than an inner diameter of the conduit is not discussed.

Anderson teach in Figure 1 a plasma apparatus. The apparatus comprises a bell jar 11. The bell jar 11 is mounted on a base 12 and a vacuum seal is provided between the bell jar 11 and the base 12 by simply utilizing conventional gasket type sealed or similar devices. (Column 1 lines 54-64)

In order to reduce the volume of gas which is energized and thus reduce the developed high temperatures, a second envelope or tube 14 is utilized. This tube 14 extends into the

envelope or bell jar 11 through the walls of the jar. This tube 14 encloses a second zone wherein ionization is accomplished. An extension 16 of the tube 14 extends beyond the zone 13 and thus is not within the bell jar 11. This extension 16 is a closed volume. Portion 17 of the tube 14 extends into the zone 13 and contains an opening 18 which communicates with zone 13. Thus it is noted that the zone 19, established by the tube 14, and the zone 13 communicate through the opening 18 in the tube 14. This means that the type of gas an the pressure of that gas within zone 19 is the same as that which exists in the zone 13. (Column 2 lines 10-24)

Energy may be applied to the system by any number of methods. For example, A.C. particularly radio frequency (R.F. energy) may be applied to the extension 16 of tube 14. This R.F. energy is applied by utilizing an R.F. loop 27. The R.F. loop is situated close to the extension 16 so that the electrical field developed by the radio frequency energy in the loop 27 ionizes the mercury or other gas which is in the zone 19. An R.F. source 28 may be connected to the R.F. loop 27 by suitable switches. It is to be noted that R.F. energy is preferred, however A.C. energy of other frequencies than those lying in the radio frequency band may be utilized with success. (Column 2 lines 37-49)

The motivation for providing a coil antenna between the conduit and the chamber with the winding having an outer diameter than an inner diameter of the conduit is that it allows for reduction in temperature. (Column 2 lines 10-12)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified Reinberg et al. by utilizing as taught by Anderson because it allows for reduction in temperature.

7. Claims 1, 4, 5, 6, 8, 9, 10, 12, 13, 14, 20, 21, 22, 24, 27, 28, 34 and 36 are provisionally rejected under 35 U.S.C. 103(a) as being obvious over copending Application No. 09/584,167 which has a common assignee with the instant application in view of Smith et al. (U.S. Pat. 4,431,898) and Anderson (U.S. Pat. 3,291,715). Based upon the earlier effective U.S. filing date of the copending application, it would constitute prior art under 35 U.S.C. 102(e) if patented. This provisional rejection under 35 U.S.C. 103(a) is based upon a presumption of future patenting of the conflicting application.

Application No. 09/584,167 teach the plasma reactor with the hollow conduit required by the claims.

The differences not discussed is that the tube being a metal is not discussed, dividing the tube is not discussed, a coil winding between the conduit and the chamber is not discussed and wherein the winding has an outer diameter less than an inner diameter of the conduit is not discussed.

Smith et al. discussed above and teach the tube being metal and dividing the tube. (See Smith et al. discussed above)

The motivation for utilizing a metal chamber with a dielectric break is that it allows for preventing induced current flow from forming in the plasma chamber. (See Smith et al. Column 9 lines 12-13)

Anderson is discussed above and teach a coil winding between the conduit and the chamber and wherein the winding has an outer diameter less than an inner diameter of the conduit. (See Anderson discussed above)

The motivation for providing a coil antenna between the conduit and the chamber with the winding having an outer diameter than an inner diameter of the conduit is that it allows for reduction in temperature. (See Anderson discussed above Column 2 lines 10-12)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified Application No. 09/584,167 by utilizing a metal chamber with a dielectric break as taught by Smith et al. and to have provided a coil antenna between the conduit and the chamber with the winding having an outer diameter than an inner diameter of the conduit as taught by Anderson because it allows for preventing induced current flow from forming in the plasma chamber and for reduction in temperature.

This provisional rejection might be overcome either by a showing under 37 CFR 1.132 that any invention disclosed but not claimed in the copending application was derived from the inventor of this application and is thus not the invention "by another," or by a showing of a date of invention for the instant application prior to the effective U.S. filing date of the copending application under 37 CFR 1.131.

Double Patenting

8. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. See *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970);and, *In re Thorington,* 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321© may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent is shown to be commonly owned with this application. See 37 CFR 1.130(b).

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

9. Claims 1, 4, 5, 6, 8, 9, 10, 12, 13, 14, 20, 21, 22, 24, 27, 28, 34 and 36 are provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claim of copending Application No. 09/584,167 in view of Smith et al. (U.S. Pat. 4,431,898) and Anderson (U.S. Pat. 3,291,715).

Application No. 09/584,167 teach the plasma reactor with the hollow conduit required by the claims.

The differences not discussed is that the tube being a metal is not discussed, dividing the tube is not discussed, a coil winding between the conduit and the chamber is not discussed and wherein the winding has an outer diameter less than an inner diameter of the conduit is not discussed.

Smith et al. discussed above and teach the tube being metal and dividing the tube. (See Smith et al. discussed above)

The motivation for utilizing a metal chamber with a dielectric break is that it allows for preventing induced current flow from forming in the plasma chamber. (See Smith et al. Column 9 lines 12-13)

Anderson is discussed above and teach a coil winding between the conduit and the chamber and wherein the winding has an outer diameter less than an inner diameter of the conduit. (See Anderson discussed above)

The motivation for providing a coil antenna between the conduit and the chamber with the winding having an outer diameter than an inner diameter of the conduit is that it allows for reduction in temperature. (See Anderson discussed above Column 2 lines 10-12)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified Application No. 09/584,167 by utilizing a metal chamber with a dielectric break as taught by Smith et al. and to have provided a coil antenna between the conduit and the chamber with the winding having an outer diameter than an inner diameter of the conduit as taught by Anderson because it allows for preventing induced current flow from forming in the plasma chamber and for reduction in temperature.

This is a provisional obviousness-type double patenting rejection.

Allowable Subject Matter

10. Claims 2, 3, 7, 11, 15-19, 23, 25, 26, 30-33, 35 and 37 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claims 2 and 3 are allowable over the prior art of record because the prior art of record does not teach the hollow conduit comprising a plenum extending around the axis of symmetry of the chamber and wherein the first and second openings are comprised within a continuous opening in the enclosure extending around the axis of symmetry of the chamber.

Claims 7 and 11 are allowable over the prior art of record because the prior art of record does not teach the coil antenna comprising a second winding extending on an opposite side of and along the conduit.

Claims 15-19 are allowable over the prior art of record because the prior art of record does not teach an array of pairs of openings through said vacuum enclosure, each pair of openings near generally opposite sides of the workpiece support; an array of generally mutually parallel hollow conduits outside of the vacuum chamber that includes the one hollow conduit, and connected to respective ones of the pairs of openings, whereby to provide respective closed torroidal paths for plasm, each of the respective closed torroidal paths extending outside of the vacuum chamber through a respective one of the array of conduits and extending inside the vacuum chamber between a respective pair of the openings across said wafer surface.

Claim 23 is allowable over the prior art of record because the prior art of record does not teach the height of the closed torroidal path along an axis generally perpendicular to a plane of the wafer support in a process region overlying the workpiece support is less than elsewhere in the closed torroidal path, whereby to enhance the plasma ion density in the process region relative to the plasma ion density elsewhere in the closed torroidal path.

Claims 25 and 26 are allowable over the prior art of record because the prior art of record does not teach a conductive body comprising a gas distribution showerhead, the process gas supply being coupled to interior of the chamber through the gas distribution showerhead.

Claims 30-33 and 37 are allowable over the prior art of record because the prior art of record does not teach a first magnetic core extending between the conduit and the enclosure across at least a portion of a first half of the width, the coil antenna comprising a first winding surrounding the first magnetic core; a second magnetic core extending between the conduit and the enclosure across at least a portion of a remaining half of the width, the coil antenna further comprising a second winding wound surrounding the second magnetic core.

Claim 35 is allowable over the prior art of record because the prior art of record does not teach a vacuum enclosure comprising a longitudinal side wall and an overlying lateral ceiling, and wherein the first and second openings extend through the side walls.

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Rodney McDonald whose telephone number is (703) 308-3807. The examiner can normally be reached on Monday through Thursday from 8:00 to 5:00. The examiner can also be reached on alternate Fridays.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen, can be reached on (703) 308-3322. The fax phone number for the organization where this application or proceeding is assigned is (703) 305-3599.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

RODNEY G. MCDONALD
PRIMARY EXAMINER

RM

February 6, 2002